THE

# SCIENTIFIC JOURNAL.

*Description of a new American Salamander—The Red Back
Salamander from the Highlands.* By C. S. RAFINESQUE,
*Esq.*

I AM acquainted already with about ten species of North
American Salamanders, most of which have not yet been de-
scribed by naturalists. I have described several in my me-
moirs, presented to the Literary and Philosophical Society of
New-York, and the Lyceum of Natural History of New-York;
they generally belong to the water salamanders with com-
pressed tails. which form the genus *triturus* of Dumeril and
myself; but I now mean to describe a real land salamander,
with cylindrical tail, which has been presented to the Lyceum,
having been found by Mr. Verplanck on the Highlands: Dr.
Samuel Mott had also seen it formerly. Salamanders differ
from lizards, by having a naked skin without scales, toes without
nails, and being tadpoles, like frogs, in the first stage of their
existence.

*Salamandra erythronota.* RED BACK SALAMANDER.—*Defi-
nition.* Back red, with a black line on each side, and a
crenulated reel in the middle: belly grey, spotted of brown;
tail rather longer than the body, and blackish.

*Description.*—Total length about four inches, head very ob-
tuse, flattened, brown above, yellowish underneath, mouth
large, eyes nearly round and brown; back of a fine red, mar

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ginated with two narrow black lines, beginning behind the eyes. and ending on the tail; the middle of the back has a crenulated reel, which does not protrude on the tail, which is slender, brown, or blackish, a little obtuse at the tip, and longer than the body. The feet are small, the anterior have four toes, the posterior five, whereof the lateral ones are very short; they are entirely cleft.

*Observations.*—It is found on hills and rocky situations of the state of New-York, on the Highlands, &c. It moves slowly, and takes shelter under stones. It lives on insects.

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*Descriptions of two new Genera of North American Aquatic Worms*—Scolendus *and* Pettostoma. *By* C. S. Rafinesque.

I. Scolendus.—Body cylindrical, filiform, contractible, articulated inside, outward skin or bag not articulated, without appendages. Head and tail equal, without articulations. No eyes nor tentacles.—A singular new genus, which has the appearance of being covered by a diaphanous bag, through which the articulations of the body appear; the name implies this peculiarity. It is composed of the following species, and belongs to the second natural order *Endobranchia*, fifth natural family *Achetopia*, next to the genera *Nemoctus, Siphalis, Casentula,* &c. &c. in the class *Helmictia*, or the worms.

*Scolendus hyaleris.* Description.—A small worm half an inch long at utmost, filiform, flexuous, with an attenuated, obtuse, and smooth head; tail similar to the head: body smooth; articulations interior, about as long as broad when the animal is at rest, and reddish at their contact, forming reddish rings, on a hyalin ground, which is the general colour of the body.— Found in March, 1817, on the sea shore near New Rochelle,

in the Sound, on a rocky shore, creeping slowly on the leaves of fuci.

II. PETTOSTOMA.—Body oblong, without any appendages; back convex, with many narrow articulations; belly flat. Head underneath, sticking, round; mouth under it, shaped like a shield, and radiated. Tail not sticking. A very peculiar genus of the leech tribe, belonging to the same natural family and order; the foregoing belongs to the class of worms next to the genera *hirudo*, *celeno*, *delgemus*, &c. The name means shielded mouth. The following species will be the type of it:

*Pettostoma testudaria.* Description.—Length half an inch; total shape oblong lanceolate; tail obtuse; head rounded; mouth inside, with about ten radiated brown lines disposed round it. Back convex, with about forty narrow articulations, olivaceous—fulvous, variegated and marbled of blackish flexuous lines. Sides with one row of brown spots on an olivaceous ground. Belly olivaceous, with four longitudinal brown lines a little interrupted.—Found in May, 1816, in the Delaware, on a turtle, the *testudo pieta*, on which it clung as leeches commonly do; but only by the head; it sucks their body, and attaches itself generally on the inside of the thighs, whence its vulgar name of *turtle leech.*

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In the first number of the Journal is inserted a paper, the object of which appears to be, to explain why the leaves of the sensitive plant coalesce when touched; in which paper this phenomenon of the plant is imputed to the operation of the electric fluid, and is styled an electrical fact. It appears to me that the hypothesis is, in itself, erroneous; that it is attempted to be established on false principles, and that the only experi-

ment produced for the purpose of supporting it, has in truth
no relation to it.

It is admitted that the electric fluid pervades every sub-
stance in nature—that it is constantly active, producing those
effects for which it was intended by the Author of nature. But
we know that its operations cannot be observed, nor even its
existence demonstrated, except when its natural and ordinary
state of equilibrium is disturbed by the operations of nature, or
by the scientific interference of art.

It is a property of the electric fluid to be in a state of equi-
librium ; that is, to be distributed in bodies equally according
to their various capacities for receiving and retaining it ; and it
is its exertions to recover that state, when it has been dis-
turbed by any cause, that affords us the most powerful evidence
of its existence. In acquiring its equilibrium, the electric fluid
prefers the shortest or most direct course, even by a bad con-
ductor, to a more circuitous one, though offered by a good
conductor.

From all the facts relating to the electric fluid with which
we are acquainted, it appears that the earth is the grand reser-
voir for it, or at least that it affords a general medium of con-
veyance to the electric fluid from one body to another, and it
is not improbable, that when one body has more than its natural
share of that fluid, every other body in nature, which is con-
nected with the earth by a conductor, is deprived of some por-
tion of its natural quantity.

Electricians have divided all bodies into conductors and non-
conductors. Conductors are those substances which serve as
a medium of conveyance to the electric fluid, and non-conduc-
tors those which do not serve for that purpose, but which op-
pose the progress of that fluid. I shall not attempt to enume-
rate the various substances at present classed under these heads,
but shall content myself with observing, that water and watery
fluids, and all substances having a large portion of these fluids

in their composition or structure, do serve as conductors ; and that resin, wax, and glass, are non-conductors.

The principles which I have stated being admitted to be correct, and I believe they are sanctioned by the experience of the most respectable philosophers who have paid particular attention to the subject of electricity, I shall test the hypothesis of E. R. by them, first observing, that as the sensitive plant has a large quantity of watery fluids constantly circulating in its vessels, there can be no hesitation in admitting that it is a good conductor, and that the electric fluid may pass through it in every direction.

If the expansion of the sensitive plant depend upon an accumulated quantity of electric fluid, why does it expand when planted in the common earth, without the intervention of any non-conducting substance ? for the earth is as good a conductor as a person's hand, and moreover offers a more direct passage for the electric fluid.

Will E. R. say, that the sensitive plant is possessed of volition, as well as of perception, and that it can at will impart its accumulated electricity to one body, and refuse it to another ? Surely he does not mean to wander so far from the ordinary path of human reason and human experience ; and if he intended to turn poet on our hands, he ought to have given us fair notice, and to have styled his paper *An Argument to a Poem*, rather than an " Electrical Fact." If we suppose a sensitive plant to be placed on a cake of resin, and charged with a surplus quantity of the electric fluid, it will continue in that state until some conducting substance, having a connexion with the earth is brought in contact with it, when the electric fluid will immediately discharge itself, and acquire an equilibrium, and it will be impossible to recharge the plant so long as the conductor is kept in contact with it, but take that away, and you then may charge the plant without difficulty. Now, if you take away the resin, and set the plant on the earth, it will

immediately loose its accumulated electricity, and you will find it impossible to produce any new accumulation, so long as it is in immediate contact with the earth, and not insulated; because the electric fluid does not remain in it, but merely passes through it into the earth. Such would be the true state of the case, if the peculiar property of the sensitive plant depended upon electrical influence. Now, as the plant exhibits its wonderful property equally well when planted in the common earth as when in a pot, and insulated, it must be evident to any person the least acquainted with the science of electricity, that this property does not at all depend upon the influence of the electric fluid ; for if it did, it could never exist while the plant was in immediate contact with the earth.

The experiment which E. R. offers for the purpose of illustrating his hypothesis, bears a strong resemblance to the phenomenon of the sensitive plant, except that he directs a *cake of resin* to be used in it. Now, every electrician very well knows, that this cake of resin has no other influence in the business, than that the experiment can never be performed without it, or some other non-conductor which will be equivalent to it, for the purpose of insulating the branch of willow.

A DISCIPLE OF FRANKLIN.

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*Remarks on an Essay entitled " Electrical Fact," in No.* 1.

To the Editor.

In a paragraph entitled *Electrical Fact*, in the first number of your Journal, the motion of the sensitive plant, (*mimosa*) upon being touched, is there supposed to depend on electricity. Botanists have not been able to assign the immediate cause why the leaves of this plant fold together, and its branches drop : for my own part, I am well satisfied that the motion does

not proceed from electricity. When I first knew this plant, I was of the same opinion as your correspondent, but experiment and reflection soon convinced me of my error ; for, upon touching a healthy plant of this sort with a stick of sealing wax, and also with a glass tube, both of which, you know, are among the most perfect non-conductors of the electric fluid, the leaves collapsed, and the whole plant exhibited the same appearances as if it had been touched with the hand, or any other good conductor of electricity. Besides, on the received theory, which in this instance is certainly fact, the pores of all bodies are supposed to be full of this subtle fluid, and when its equilibrium is not disturbed, that is, when there is neither more nor less of it in a body than its natural share, or than it is capable of retaining by its own attraction, the fluid will not manifest itself to our senses. This plant would not, therefore, as your correspondent supposes, " impart a great deal of its fire, or electricity, into the thing by which it is touched."—How is it possible for this to contain a redundant portion of electricity, or to possess more of this fire than any plant whatever, when the earth in which it grows, and the moist air by which it is often surrounded, having a less quantity, (on the supposition of your correspondent,) would take from it its electricity, just in the same manner as when touched by the hand ? The illustration of your correspondent's hypothesis is, I think, not correct ; at least the experiments I performed, according to his directions, did not succeed. I took a small plant, and, after insulating it, I electrified it as high as possible with one of Nairne's machines, yet its leaves were not elevated, nor, upon being touched, did it become languid. The plant I used was the common *wall-flower.*

Your correspondent seems to suppose that the sensitive is the only plant which exhibits, as Darwin would say, this vegetable irritability : many others, however, might be enumerated; but I will only mention the catchfly, or *dionea muripula* of

North-Carolina.   The leaves of this plant are armed with teeth like a spring rat-trap, and lie spread on the ground about the stem ; they are so irritable that when a small insect creeps over them, they fold together, and often crush it to death.

The celebrated electrician, Van Marum, made some experiments on sensitive plants.   After exposing the *mimosa pudua* to the sun for the purpose of expanding its leaves, he placed it at the distance of two feet from a conductor positively electrified, and then at the same distance from a negative conductor ; but no effects were produced.   Electricity, according to his statements, occasioned no acceleration, or did in the least retard the motion of the small leaves of the *hedysarum gyrans.*

J. G.

*Princeton, Feb.* 18, 1818.

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### Method of Analyzing Spring Waters.

SPRING WATERS are generally analyzed by tests, or re-agents. The following are very delicate, and are generally used :

IRON.   Tincture of galls produces a purple precipitate.   So delicate is the gall test, says Bishop Watson, that it will tinge sensibly purple, fifteen gallons of water, in which only one grain of sulphate of iron is dissolved : fifteen gallons of water contain eight hundred and forty thousand grains avoirdupois weight.   Prussiate of potash, and prussiate of lime, are also very sensible tests of iron ; the precipitate formed by them is the beautiful pigment, *Prussian blue.*

COMMON SALT.   A saturated solution of muriate of mercury made without heat.   The sensibility of this test, Dr. Henry tells us, is so great, that one part of muriatic acid of the specific gravity 1.500 diluted with 300.000 parts of water, is indi-

cated by a slight dull tint, ensuing on the addition of this test. Muriat, nitrat, and acetate of silver, are excellent tests of muriatic acid and its combinations.

ALKALIES. Turmeric paper, the yellow colour of which is changed to brown.

ACIDS IN GENERAL. Litmus paper. The blue colour is soon changed to red, if the acid be a fixed one, or a volatile one ; if a volatile one, the colour of the paper will not be changed after the water has been boiled.

SULPHURIC ACID. Muriat of barytes forms a white precipitate, insoluble in muriatic acid.

CARBONIC ACID. Lime water, when mixed with an equal quantity of water under examination, will produce a white precipitate, soluble in muriatic acid, with effervescence.

LIME. Oxalate of ammonia occasions a white precipitate in water, holding a very small portion of this earth in solution.

D. DANN.

## On the Physiology of the Egg.

MR. J. A. PARIS, in a letter to Mr. Maton, has made the following observations on the physiology of the egg, which will, perhaps, be entertaining to the readers of the Scientific Journal ; as such, I send them for insertion in the first number.

" The albuminous portion of the egg is destined not only to afford nourishment to the ovular embryo, but also to assist in maintaining that equable temperature which is so necessary to the future evolution of the germ ; because, being a very feeble conductor of caloric, it retards the escape of heat, prevents any sudden transition of temperature, and thus averts the fatal chills which the occasional migrations of the parent might induce. That the principal use of the follicle, or air-bag, at

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the obtuse end, is to oxygenate the blood of the chick, if not demonstrated, is rendered highly probable from the circumstance of the bag having been found, by experiment, to contain *atmospheric air*. This follicle, as far as his observations extended, appeared to be larger in the eggs of those birds which place their nests on the ground, and whose young are hatched fledged, and capable of exerting their muscles as soon as they leave the shell, than in the eggs of those whose nests are built in trees, and whose progeny come forth blind and forlorn. Thus the folliculi in the eggs of fowls, partridges, and moor-hens, are larger than those of crows, doves, &c. which are extremely contracted; and we may observe that fowls and partridges have a more perfect plumage, and a greater aptitude to locomotion than the callow nestlings of doves or crows.

Mr. Paris observes, with Fordyce, that a deficiency of calcareous matter is the cause of the absence of the involucrum, or shell of the egg, which is sometimes observed; though he contends that this deficiency originates, not in the privation of the calcareous principle, but in some internal state of the system. A hen, says he, which I kept for some experiments, had its leg broken in two places. The bandage was applied to the fractures, three days subsequent to which several eggs without shells were found on the premises. The hen had deposited no perfect eggs, nor were there any other birds from which these yolks could have fallen; I therefore conjectured that all the calcareous matter designed for the formation of the shell, had been employed in the regeneration of the bone.

H. BROWN.

## Ancient Division of Time.

THE following is from a very valuable M. S. in vellum, in the Ashmoleian Museum, the author of which was Byrdferthus, a monk of Ramsey, who lived in the reign of King Ethelred.

" Five hundred and sixty-four *atoms* make a *moment*, four moments a *minute*, two minutes and a half a *prick* or *point*, four pricks or points a *tid* or *hour* in the course of the sun, six tids a *fyrthling*, four fyrthlings a *day*, and seven days a *week*.

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MR. MARRAT,

I am glad to observe, that in your Scientific Journal, you are disposed to prefer what is useful to what is merely curious. The fashionable science of Chemistry, will, I trust, through your Journal, furnish, as it is well calculated to do, many useful suggestions in domestic economy. That I may contribute my mite, I send you what follows, which I have verified by experiment.

G———.

Princeton, Feb. 17th, 1818.

Wine decanters, and other glass vessels with glass stoppers are occasionally rendered useless, by the stoppers becoming so firmly fixed in the necks or mouths of the vessels as to be incapable of removal by the fingers. If a vessel so circumstanced be plunged into hot water, very nearly to the top of the neck or mouth, yet so as not to let any of the water run over the top and touch the stopper, the heat of the water will presently expand the neck or mouth of the vessel, so that the stopper may be lifted out without any force whatever. The operation must, of course, be performed before the heat has had time to extend its influence to the stopper.

## USEFUL RECEIPTS.

### For stopping and curing a Gangrene.

Take one pint of strong beer, and a pint of water, and, in a wine glass of water, dissolve as much *pearl-ash* as can be dissolved in it. Mix all these together, and put them in a bottle, which must be well corked, to preserve the mixture. In this liquid soak good light wheat bread, and apply it to the gangrene in the form of a poultice ; renew the application frequently, and a speedy cure will follow. N. B. The mixture must not be boiled, or made more than new milk warm.

This is inserted by particular request, as many cures have been effected by it.

### To discharge Stains, Ironmoulds, Grease Spots, &c.

To discharge ink stains or ironmoulds from wood or cloth, liver of sulphur should first be applied, in solution ; after this is well washed off, the juice of lemon, or any other vegetable acid, should be applied. To discharge stains from wine or fruits ; put a tablespoon full of muriatic acid into a tea-cup, and add to it a teaspoon full of powdered manganese ; set the cup in a larger one fill d with hot water; moisten the stained part with water, and expose it to the fumes till the stain disappears. This is only applicable to articles that are white. Grease spots are removed by a diluted solution of pure potash, or caustic lie. Stains of white wax are taken out by spirits of turpentine ; and the marks of white paint by sulphuric ether. Stains of fruit, or wine, on silk, may be removed by a watery solution of sulphureous acid, or by the fumes of burning sulphur.

### To take Grease out of Books, Prints, &c.

After having gently warmed the paper that is stained with grease, oil, or any fat substance, take as much out of it as possible with blotting paper, this done, dip a small brush in the essential oil of turpentine, heated almost to ebulition, and draw it gently over both sides of the paper, which must be kept warm; repeat this operation as often as may be found necessary. When the grease, &c. is removed entirely, dip another brush in highly rectified spirits of wine, and draw it in like manner over the place that was stained, and particularly round the edges; by these means the spot may be made to totally disappear, the paper will assume its original whiteness, and the writing, or printing will experience no alteration.

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## PHILOSOPHICAL QUESTIONS,

#### PROPOSED FOR DISCUSSION IN FUTURE NUMBERS.

### Qu. 1. By *Mr. A. Hirst.*

THE manufacture of cotton has arrived at such perfection, that cotton yarn has been substituted in silk articles, to which it bears so close a resemblance, as almost to deceive the best judges; required an easy practical method of detecting this ingenious fraud?

### Qu. 2. By *Mr. Harrison.*

Why will not wax convey the electric fluid equally as well as iron?

### Qu. 3. By *J H N.*

From whence proceeds the sweet and glutinous fluid, generally termed " honey dew," which is frequently found on the foliage of trees during the summer months ?

### Qu. 4. By *Mr. Harrison.*

A pound of brass in a lump, will fuse in less time than the same weight will do in filings ; required the reason ?

### Qu. 5. By *A Store-Keeper.*

Required a cheap method of clarifying fish oil, and divesting it of its fœtid smell ?

### Qu. 6. By *Mr. Nowell.*

The Prussic acid is capable of combining with pot-ash, and forming a salt extremely prone to decomposition  But this proneness to decomposition may be done away with, by adding a quantity of iron dissolved in an acid ; in this case, how does the iron operate ?

### Qu. 7. By *Mr. Rt. Maar, New-York.*

Let two spherical balls be made of different metals, as, suppose, of gold, and silver, but exactly of the same weight, and size, consequently the gold ball may assume the form of a spherical orb or hollow sphere : now, if these balls be painted white, is there any method known, by which it can be ascertained which is the golden ball, and which is the silver one ?

# MATHEMATICAL CORRESPONDENCE.

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Mr. Editor,

The series of Euler for the circumference of the circle, which you have mentioned in your last No., as being among the best for computation which have been yet discovered, can be made more rapidly converging, without increasing either their number, or the difficulty of computing their terms. It occurred to me when I first saw these series in his Analysis of Infinites, that the arc whose tangent is $\frac{1}{2}$, might possibly be resolved into two others, the tangent of one of which should be $\frac{1}{3}$, and the numerator of the other, unity. This conjecture was verified, by making $x$ the tangent of the remaining arc, and reducing the common equation for the tangent of the sum of two arcs. When $\frac{1}{2}$ is the tangent of the whole, and $\frac{1}{3}$ and $x$ are the tangents of the parts, this equation becomes $\frac{1}{2}=\dfrac{\frac{1}{3}+x}{1-\frac{1}{3}x}$; which reduced, gives $x=\frac{1}{7}$. Hence it appears, that the arc whose tangent is $\frac{1}{2}$, is equal to the sum of the arcs whose tangents are $\frac{1}{3}$ and $\frac{1}{7}$; and, therefore, the arc whose tang. $=\frac{1}{7}$, + twice the arc whose tang. $=\frac{1}{3}$, is equal to the arc whose tang. $=\frac{1}{2}$, or to $\frac{1}{4}$ c. By expanding the series for these arcs, we obtain,

$$\frac{1}{4}c = \begin{cases} 2\left(\dfrac{1}{3} - \dfrac{1}{3.\,3^3} + \dfrac{1}{5.\,3^5} - \dfrac{1}{7.\,3^7} + \&c.\right) \\[2ex] \times\ \dfrac{1}{7} - \dfrac{1}{3.\,7^3} + \dfrac{1}{5.\,7^5} - \dfrac{1}{7.\,7^7} + \&c. \end{cases}$$

The first of these series is the same with one of Euler's; but the second converges by the powers of 7 instead of 2, and 10

terms of it will give a result as accurate as 28 terms of his other ; as will readily appear by reducing the equation $7^{20-1} = 2^{2x-1}$, in which the value of $x$ will show at what term of his series the denominator becomes equal to that of the 10th term in the one given above.

If we attempt to repeat this operation by resolving the arc whose tan. is $\frac{1}{3}$ into two others, the tangent of one of which shall be $\frac{1}{7}$, we obtain $x = \frac{2}{11}$, the powers of which, although more converging, are not so convenient for numerical computation as those of $\frac{1}{3}$. If we were to resolve this arc into two parts, the tangent of one of which is not $\frac{1}{7}$, we should have three series to compute instead of two ; so that the form given above is probably the best which the series in question can assume.

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**Y.,** *of New-Haven.*

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### MATHEMATICAL QUESTIONS, IN No. I,

#### ANSWERED.

### Qu. 1, *answered by Y. of New-Haven.*

It has been agreed on, as a part of the algebraic notation, that the value of a fraction whose numerator and denominator are any powers of the same quantity, shall be denoted by that quantity with an index, which is the excess of the exponent of the numerator above that of the denominator, algebraically denominated.

Hence $\dfrac{a1}{a1} = 1 = a^{1-1} = a^0$. This is the result of a general system of notation which has the advantage of subjecting the indices, whether positive, negative, or fractional, to the same rules of operation ; and is rather an object of definition, or arbitrary convention, than of proof.

*Philomathe* says; From the nature of algebraic notation $a^{m-n} = \dfrac{a^m}{a^n}$, whatever may be the values of $a$, $m$ and $n$; and when $m = n$, then $a^0 = 1$. *Mr. Davis* observes that, because in the series $a$, $a^2$, $a^3$, &c. each term is deduced from the preceding by multiplying by $a$, so, conversely, each term may be deduced from the succeeding term by dividing by $a$, and the indices decrease by one regularly; therefore $a = a^1$ divided by $a = a^0 = \dfrac{a}{a} = 1$. *Mr. M. O'Connor*, says; It is well known that any power of a number gives as quotient a power whose exponent is that of the dividend, diminished by that of the divisor, therefore $\dfrac{a^m}{a^n} = a^{m-m} = a^0 = 1$. *Mr. Nolan*, puts $a^0 = x$, then multiplying both sides of the equ. by $a$, we have $a^{0+1}$, or $a = ax$, and $x = \dfrac{a}{a} = 1$.

*Analyticus* gives several modes of proof, similar to what is given above, and two others drawn from the nature of logarithms, to which he adds the following scholium; The formula $a^0$ is not the only one independent of the radix $a$; the formula $a^{\frac{1}{\log \cdot a}}$ is also a constant quantity, and its log. is $a^0$.

### Qv. 2, *answered by Philomathe, New-York.*

By the nature of logarithms, $l\,3\,a^2 + l\,a^4 + 5\,l\,3 = l\,(3\,a^2 \times a^4 \times 3^5) = l\,(3\,a)^6$; and in the same manner it was answered by all our other correspondents.

### Qv. 3, *answered by Y.*

Multiplying the first equ. by $xy$, and resolving the left hand side of the second into factors, we reduce them to the form $x + y = bxy$, and $xy \times (x + y) = a$; substituting in the 2d, $bxy$ for $x + y$,

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there results $bx^2y^2 = a$, and $xy = \sqrt{\dfrac{a}{b}}$.   And because $x+y = \dfrac{a}{xy}$,

it is equal to $a\sqrt{\dfrac{a}{b}} = \sqrt{ab}$. Having then the sum and rectangle of

$x$ and $y$, by exterminating $y$, we have $x^2 - \sqrt{ab} \times x + \sqrt{\dfrac{a}{b}} = 0$,

whence $x = \frac{1}{2}\sqrt{ab} \pm \sqrt{(\frac{1}{4}ab - \sqrt{\dfrac{a}{b}})}$, and as $x$ and $y$ enter alike, the

two roots, thus formed, are their required values.

*Philomathe*, and *Mr. O'Connor*, proceed thus. The first equ.
$\times$ *by* the second gives $x^2 + 2xy + y^2 = ab$, whence $x+y = \sqrt{ab}$;
and dividing the second by this last, gives $xy = a \div \sqrt{ab}$. Now
from the first equ. $\times$ *by* the second, take two times the last, and
we have $x^2 - 2xy + y^2 = ab - (4a \div \sqrt{ab})$, hence $x-y = \sqrt{(ab - 4a \div \sqrt{ab})}$. We have thus given the sum and difference of two
quantities, to determine those quantities, which is easily effected.

### Again, by Mr. Wm. Wood, of New-York.

From the first equ. $x + y = bxy$, and $xy = (x + y) \div b$ ;
from the second, $xy \times (x + y) = a$, and $xy = a \div (x$ and $y)$ ;
hence by equality $(x + y) \div b = a \div (x + y.)$ This cleared
of fractions becomes $x^2 + 2xy + y^2 = ab$, or $x + y = \sqrt{ab}$.
Now, since $x + y = bxy$, we have $\sqrt{ab} \div b$, and if from $x^2 +
2xy + y^2$ we take $4xy = 4\sqrt{ab} \div b$, there will remain $x^2 -
2xy + y^2 = ab - 4\sqrt{ab} \div b$, or $x - y = \sqrt{(ab - 4\sqrt{ab} \div b)}$, therefore, &c. as in the former solutions. The solutions
by *Messrs. Nolan*, and *Davis*, were similar to this last.

### Qu. 4, answered by Analyticus.

Let $x, y, z$ and $u$, be the numbers sought, $a, b, c$ and $d$, the
four given numbers; then, by the question,

$$x + y + z + u = a$$
$$x^2 + y^2 + z^2 + u^2 = b$$
$$x^3 + y^3 + z^3 + u^3 = c$$
$$x^4 + y^4 + z^4 + u_{\cdot}^4 = d.$$

But $a - u = A$, $b - u^2 = B$, $c - u^3 = C$ and $d - u^4 = D$, then we have

$$x + y + z = A$$
$$x^2 + y^2 + z^2 = B$$
$$x^3 + y^3 + z^3 = C$$
$$x^4 + y^4 + z^4 = D.$$

Now, by raising the equation $x + y + z = A$, to the 4. power, $x^4 + y^4 + z^4 + 4 (x^3y + x^3z + y^3z + z^3x + z^3y) + 6 (z^2y^2 + x^2z^2 + y^2z^2) + 2 (x^2yz + y^2xz + z^2xy) = A^4$. The quantity mult. by 6, is evidently the sqr. of $(xy + xz + yz) =$

$$\frac{A^2 - B}{2} = E, \text{ by substitution.}$$

Again, the quantity multiplied by 4, is evidently $= AC - D$, and $z^4 + y^4 + z^4 = D$; whence, therefore, by substitution

$$4AC - 3D + 6E^2 = A^4,$$
$$\text{or, } A^4 - 4AC + 3D - 6E^2 = 0.$$

In this equation substitute for $A$, $C$, $D$, $E$, their values in terms of $u$, and we obtain,

$$u^4 - au^3 + \frac{a^2 - b}{2} u^2 - \frac{a^3 - 3ab + 2c}{6} u +$$

$$\frac{a^4 - 6a^2 b + 8ac + 3b^2 - 6d}{24} = 0.$$

In numbers $u^4 - 24 u^3 + 199 u^2 - 660 u + 700 = 0$.

To reduce this equation to a simpler form, let us take away the second term, by the common rule, which requires us to substitute $v + \frac{24}{4}$, or $v + 6$, instead of $x$, and the equation becomes $v^4 - 17 v^2 + 16 = 0$. This quadratic resolved by the common rules for quadratics, gives for $v$ the four roots $- 4, - 1$,

+ 1, + 4; and these roots increased by 6, are 2, 5, 7, and 10; the numbers sought.

### *Again by* Y.

Because the required quantities are alike affected in the given equations, they must depend on the resolution of some biquadratic equ. of which they are the roots. Let that equ. be denoted by $x^4 - Px^3 + Qx^2 - Rx + S = 0$; in which the co-efficients, $P$, $Q$, &c. are to be determined. It is well known that the co-efficient of the 2. term of an equation descending by the powers of the unknown quantity is equal to the sum of its roots with their signs changed; that of the 3. to the sum of the products of every two; that of the 4. to the sum of the products of every three, with their signs changed, &c. The relation between these sums, and the sums of the powers of the roots belonging to any equ. is such, that the latter can be determined from the former, (see Lacroix's Alg. Comp.) and by a reverse process we shall be able to determine the former from the latter. For this purpose, let $a$, $b$, $c$, $d$, denote the given sums of the 1st, 2d, 3d, and 4th powers of the roots, we have, from transposition, &c. from the equations in Simpson's Alg. p. 130. $P = a$, $Q = \frac{1}{2}(P - b)$, $R = \frac{1}{3}(-P^3 + 3PQ + c)$, and $S = \frac{1}{4}(P^4 - 4P^2Q + 4PR + 2Q^2 - d)$. The values of $P$, $Q$, &c. being successively determined from these equ. with the given numerical values of $a$, $b$, $c$, and $d$, the assumed equ. is found by substitution to be $x^4 - 24 x^3 + 199 x^2 - 660 x + 700 = 0$, the roots of which are 2, 5, 7, 10 = the numbers required. This method is general, and will enable us to determine any unknown quantities, when the sums of their powers from the 1. to the nth. inclusive, are given.

The answer by *Philomathe*, is on exactly the same principles. Very elegant solutions to this problem, were given by Mr. *O'Connor*, and Mr. *W. Wood*, but for want of room we are obliged to omit inserting them.

### Qv. 5, *answered by Analyticus.*

Let $a =$ half the given length of the wire, and $A = \frac{1}{2}$ the given angle ; then, the mass will be expressed by $2\,a$, and the distance of the centre of gravity from the point of suspension by $\frac{1}{2}\,a$ cos. $A$, which mult. by $2\,a$ gives $a^2$ cos. $A =$ the product of the mass by the dist. of the centre of gravity from the point of suspension.

Again ; let $x$ denote any variable part of $a$, reckoning from the point of suspension, and $x^2 \times dx = x^2\,dx$, is the moment of inertia of the element $dx$, the fluent of which, or $\frac{1}{3}\,x^3$ is the moment of $x$ ; which, taking $x = a$, and doubling for both sides of the pendulum, becomes $\frac{2}{3}\,a^3$ for the whole moment of inertia. This divided by $a^2$ cos. $A$ gives $\frac{2}{3} \times \dfrac{a}{\text{cos. } A} = \frac{2}{3}\,a$ sec $A$, or $\dfrac{l}{3}$ sec $A$, for the distance of the centre of oscillation from the point of suspension.

Cor. 1. If we would have the angular pendulum to beat seconds, put $p = 39\frac{1}{8}$ inches $=$ length of a simple pendulum beating seconds, and we shall have $\dfrac{l}{3}$ sec $A = p$ ; whence sec $A = \dfrac{3p}{l}$. From this equ. we can readily determine $A$ when $p$ is given, but when $l$ is greater than $3\,p$, the equ. sec $A = 3\,p \div l$ is evidently impossible.

Cor. 2. If in a given circle there be drawn from a point in the circumference, any two equal chords, these chords will form an angular pendulum that will always vibrate in the same time, whatever may be the angle contained by the equal chords.

Mr. *O. Shannessy's* letter did not arrive till the mathematical department was sent to the press ; his solution to the 4th Qu. was extremely ingenious, and solved by a quadratic equa-

tion. The numbers in this question admit of such a solution, but the question cannot be solved *generally*, but by a biquadratic equation. Mr. *R. Tagart*, New-York, also solved it by a quadratic, in a very ingenious manner. See No. 3.

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## MATHEMATICAL QUESTIONS,

### TO BE ANSWERED IN NO. 5.

#### Qu. 16. By *Analyticus.*

A gentleman having a large family, and a small carriage, wants to visit a friend at the distance of 9 miles ; half the party first get in to ride, while the other half follow after on foot ; now admitting that the coach travels at the rate of 7 miles an hour, and the pedestrians at the rate of 3, how far must the first party ride, so that, sending back the carriage for the latter, they may all arrive at the end of their journey at the same time?

#### Qu. 17. By *Mr. Davis, New-York.*

Inscribe an equilateral triangle in a given square.

#### Qu. 18. By *Rt. Maar, New-York.*

The altitude of any inaccessible object, is equal to the distance between any two stations, taken in the same right line, divided by the difference between the natural co-tangents, subtended by the object at those stations; required the demonstration.

#### Qu. 18. By *Analyticus.*

A new road is to be made across a conical mountain, the altitude of which is one mile, and the diameter of the base 10 miles; now the road must lead from one extremity of a meri-

dional diameter of the base, to the other ; it is required to locate this road, so that the distance along it, over the mountain, may be the shortest possible.

### Qu. 19. By *Tommy Tangent.*

What number differs the least from its common logarithm ?

### Qu. 20. By *Mr. J. Laidlow, Teacher, Brooklyn.*

Suppose the specific gravity of iron to be $7\frac{1}{2}$ times that of water, required the thickness of a spherical shell of iron, the inner diameter of which is one foot, that will sink in water till the centre of the sphere is in the same level with the *surface* of the water ?

### Qu. 21. By *Mr. J. Laidlow.*

Find two numbers, such, that their sum may be 32, and the sum of their cubes *minus* the sum of their squares equal 8056.

### Qu. 22. By *Y. of New-Haven.*

Find the area of the curve whose differential equation is $ddy = dz^2$ ; $x$, $y$, and $z$, denoting the abscissa, ordinate, and curve, respectively ; and the differential of the abscissa being supposed constant.

### Qu. 23. By *Philomathe, New-York.*

Required the equation of the curve whose subtangent is equal to the length of its corresponding arc.

## ACKNOWLEDGMENTS TO CORRESPONDENTS, &c.

THE following is a list of the names, and places of residence, of the gentlemen who have favoured us with solutions to the questions in the first number; the numbers denote the numbers of the questions as they stands in the work,

| | 1. | 2. | 3. | 4. | 5. |
|---|---|---|---|---|---|
| Analyticus, New-York, | 1. | 2. | 3. | 4. | 5. |
| Mr. C. Davis, New-York, | 1. | 2. | 3. | 4. | 5. |
| Mr. Rt. Maar, New-York, | 1. | 2. | 3. | 4. | 5. |
| Mr. P. Nolan, New-York, | 1. | 2. | 3. | 4. | |
| Mr. M. O'Connor, New-York, | 1. | 2. | 3. | 4. | 5. |
| Philomathe, | 1. | 2. | 3. | 4. | 5. |
| Mr. O. Shannessy, Albany, | 1. | 2. | 3. | 4. | 5. |
| Mr. R. Tagart, New-York, | | 2. | 3. | 4. | |
| Mr. Wood, New-York, | 1. | 2. | 3. | 4. | |
| Y. of New-Haven, | 1. | 2. | 3. | 4. | 5. |